

What is claimed is:

1. An adjustable measurement system for evaluating characteristics of a sample using an x-ray probe beam, comprising:

- 5           an adjustable x-ray source that generates the x-ray probe beam, where a width of the x-ray probe beam can be modified depending on the sample being evaluated;
- an optical system for focusing the x-ray probe beam onto the surface of the sample, such that the x-ray probe beam is reflected off the sample;
- a detector that receives the x-ray probe beam reflected off the sample, and  
10       generates a plurality of signals in response to receiving the x-ray probe beam; and
- a processor for analyzing the plurality of signals generated by the detector to evaluate characteristics of the sample.

2. The adjustable measurement system of claim 1 wherein the adjustable x-ray  
15       source comprises:

- an x-ray emission material that generates x-rays;
- a housing that contains the material, where the housing has an aperture through which the x-ray probe beam is projected toward the optical system;
- an adjustable mounting for holding the x-ray emission material, such that the  
20       position of the x-ray emission material can be adjusted relative to the aperture.

3. The adjustable measurement system of claim 2 further comprising a first motor coupled to the adjustable mounting, and controllable by the

processor such that the processor can adjust the position of the x-ray emission material relative to aperture.

4. The adjustable measurement system of claim 1 further comprising a means for  
5 adjusting a take-off angle of an x-ray emission material contained in the adjustable x-ray source, thereby adjusting the resolution of the system.

5. The adjustable measurement system of claim 3 further comprising:

10 a detector position adjustor for adjusting the position of the detector relative to the sample, wherein the detector is mounted to detector position adjustor so that the position of the detector can be adjusted.

15 6. The adjustable measurement system of claim 5 wherein the detector position adjustor comprises a track, and a carriage which is engaged with the track, such that the carriage can be moved to a plurality of positions relative to the track, and wherein the detector is mounted to the carriage.

7. The adjustable measurement system of claim 5 further comprising a second motor coupled to the detector position adjustor and controllable by the processor such that  
20 the processor can adjust the position of the detector by sending a signal to the second motor.

8. The adjustable measurement system of claim 3 wherein the processor analyzes characteristics of the x-ray probe beam received by the detector, and based on the analysis

generates a signal that causes the first motor to adjust the position of the x-ray emission material relative to the aperture.

9. The adjustable measurement system of claim 7 wherein the processor analyzes characteristics of the x-ray probe beam received by the detector, and based on the analysis sends a signal to the second motor to which causes the second motor to adjust the position of the detector.

10. The adjustable measurement system of claim 1, further comprising a manual adjustor coupled to the adjustable x-ray source such that an user can manually adjust a characteristic of the x-ray probe beam.

11. The adjustable measurement system of claim 1 further comprising:

a detector position adjustor, wherein the detector is coupled to the detector position adjustor such that the detector can be moved relative to the sample; and

a manual adjustor coupled to the detector position adjustor such that a user can manually adjust the detector position adjustor.

12. The adjustable measurement system of claim 3 further comprising:

an user input device coupled to the processor, which allows the user to input information to the processor regarding the sample to be measured; and

wherein the processor operates to analyze user input information regarding the sample, and based on this information adjusts the position of the adjustable mounting.

13. The adjustable measurement system of claim 7 further comprising:  
an user input device, coupled to the processor, which allows the operator to  
input information regarding the sample to be measured;

5 wherein the processor operates to analyzes the information regarding the  
sample, and based on this information adjusts the position of the detector.

14. An adjustable measurement system for evaluating characteristics of a sample  
using an x-ray probe beam, comprising:

10 an x-ray source that generates the x-ray probe beam;  
an optical system for focusing the x-ray probe beam onto the surface of the  
sample, such that the x-ray probe beam is reflected off the sample;  
a detector which receives the x-ray probe beam reflected off the sample, and  
generates a plurality of signals in response to receiving the x-ray probe beam;  
15 a detector position adjustor wherein the detector is mounted to the detector  
position adjustor, and the detector position adjustor can move the detector to a  
plurality of positions relative to the sample being detected, where the position is  
determined by characteristics of the sample being evaluated; and  
a processor for analyzing the plurality of signals generated by the detector to  
20 evaluate characteristics of the sample.

15. The adjustable measurement system of claim 14 wherein the detector position adjustor includes a track and a carriage engaged with the track such that the carriage can moved along the track, and wherein the detector is mounted to the carriage.

5 16. The adjustable measurement system of claim 15 further comprising a motor coupled to the detector position adjustor which is controllable by the processor such that the processor can adjust the position of the detector relative to the sample, by sending a signal to the motor.

10 17. The adjustable measurement system of claim 14 further comprising a manual adjustor coupled to the detector position adjustor such that a user can manually adjust the position of the detector, based on the sample being measured.

15 18. The adjustable measurement system of claim 16 wherein the processor analyzes the x-ray probe beam received by the detector, and based on the analysis generates a signal that causes the motor to adjust the position of the detector.

19. The adjustable measurement system of claim 16 further comprising:  
an user input device, which allows the operator to input information regarding  
20 the sample to be measured;

wherein the processor operates to analyze the information regarding the sample and based on this sends a signal to the motor.

20. A method for making adjustments to a measurement system for evaluating a plurality of different samples, the method comprising:

generating an x-ray probe beam using an x-ray source, which includes an x-ray emission material;

5 focusing the x-ray probe beam onto an one of the plurality of different samples;

detecting the x-ray probe beam after it has been reflected off the one of the plurality of different samples;

10 generating a plurality of signals corresponding to the detected x-ray probe beam;

analyzing the plurality of signals to evaluate the one of the plurality of different samples; and

15 adjusting the resolution of the system based on the analysis of the plurality of signals.

21. The method of claim 20 further wherein the adjusting of the resolution of the system comprises adjusting a take off angle of the x-ray emission material.

22. A method for making adjustments to a measurement system for evaluating a sample, the method comprising:

generating an x-ray probe beam using an x-ray source which includes an x-ray emission material;

focusing the x-ray probe beam onto the sample;

detecting the x-ray probe beam after it has been reflected off the sample  
generating a plurality of signals corresponding to the detected x-ray probe  
beam;

analyzing the plurality of signals to evaluate the sample;

5 receiving user input information regarding the thin film sample to be  
measured; and

based on the user information adjusting the resolution of the system.

10 23. The method of claim 22 further wherein the adjusting of the resolution  
comprises adjusting a take off angle of the x-ray emission material.

24. A method for making adjustments to a measurement system for evaluating a  
sample, whereby adjustments change a resolution of the system, the method comprising:

generating an x-ray probe beam;

15 focusing the x-ray probe beam onto the sample;

detecting the x-ray probe beam after it has been reflected off the sample

generating a plurality of signals corresponding to the detected x-ray probe  
beam;

analyzing the plurality of signals to evaluate the sample; and

20 in response to the analysis, moving the detector relative to the sample to  
change the resolution of the system.

25. A method for making adjustments to a measurement system for evaluating a sample, whereby adjustments change a resolution of the system, the method comprising:

generating an x-ray probe beam;  
focusing the x-ray probe beam onto the sample;  
5 detecting the x-ray probe beam after it has been reflected off the sample;  
generating a plurality of signals corresponding to the detected x-ray probe beam;  
beam;  
receiving user input information regarding the sample to be evaluated; and  
in response to the user input information regarding the sample, moving the  
10 detector relative to the sample to change the resolution of the system.

26. An adjustable measurement system for evaluating characteristics of a sample using an x-ray probe beam, comprising:

15 an x-ray source, which includes an x-ray emission material, that generates the x-ray probe beam;  
an optical system for focusing the x-ray probe beam onto the surface of the sample, such that the x-ray probe beam is reflected off the sample;  
a detector that receives the x-ray probe beam reflected off the sample, and generates a plurality of signals in response to receiving the x-ray probe beam;  
20 a processor for analyzing the plurality of signals generated by the detector to evaluate characteristics of the sample; and  
a means for adjusting the resolution of the system to account for characteristics of the sample.



27. The measurement system of claims 26 wherein the means for adjusting the resolution of the system includes a rotatable mounting so that a take-off angle of the x-ray emission material can be adjusted.

5

28. The measurement system of claim 26 wherein the means for adjusting the resolution of the system includes a means for adjusting the position of the detector relative to the sample.

10

29. The measurement system of claim 26 wherein the means for adjusting the resolution of the system includes a means for adjusting a take off angle of the x-ray emission material, and a means for adjusting the position of the detector relative to the sample.

15

30. An apparatus for evaluating a sample comprising:

a source of x-rays;

an optical system for focusing the x-rays onto the surface of the sample such that the x-rays create a range of angles of incidence with respect to said surface;

20

a detector having an array of individual detecting elements oriented to receive x-rays reflected from the sample having a range of angles of incidence with respect to the sample wherein each element receives a portion of the reflected x-rays with the angle of incidence of the rays striking any given individual detecting element being a function of a position of the individual detecting element within the array; and

a mechanism for adjusting an angular spread of the x-rays striking the individual detecting elements in the array so that a resolution of the apparatus can be adjusted to optimize the evaluation of the sample.

5      31. The apparatus of claim 30 wherein the mechanism controllably varies the position of the detector relative to the sample.

32. An apparatus are recited in claim 30 wherein the mechanism controllably adjusts the take-off angle of the x-ray source.

10

33. An apparatus as recited in claim 30 wherein the mechanism controllably adjusts the apparent width of the x-ray source as imaged on the sample.

15